EPA United States Environmental Protection Agency

Ecosystems Research Division

EPA On-line Tools for Site Assessment Calculation

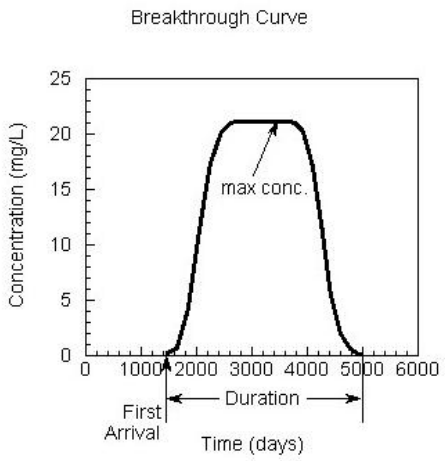
Transport from a Continuing or Pulse Concentration Source

One Dimensional Transport Equation

This calculator generates a breakthrough curve* at a receptor and uses a one-dimensional model to determine the

1. **First arrival** time for a contaminant (above a specified threshold concentration),
2. **Maximum Concentration**, and
3. **Duration** of Contaminantion above the specified threshold

*The breakthrough curve is the time history of concentration at a receptor located a specified distance from the contaminant source.



See bottom of page for equations solved.

Calculate | Clear

Save Data | Recall Data | Go Back

Example Data Set: 1 | OUST 2001

Example Description: ?1

Alternate access to example descriptions.

Inputs

Site Name: Transport Example

Date: 9/14/2011 Current Date

Aquifer Type: homogeneous unconsolidated

Distance Unit: ft

Time Unit: days

Time or Date Output: date

Chemical Data Source: EPA Subsurface Remediation Guidance

Note:
Subsurface Remediation Guidance
Table 3, EPA/540/2-90/011b

Data revision date: February 1990

Chemical: (TCE) trichloroethene trichloroethene

Porosity: 0.29

Bulk Density (ρ_b): 1.88

Fraction Organic Carbon: 0.002

Hydraulic

Conductivity (K)	250	ft/day
Gradient (i)	0.001	
Distance (x)	1800.	ft
Halflife $T_{1/2}$	730.0	days
Min. Concentration of Concern	0.005	mg/L mg/l
Source Concentration C_o	70	mg/L

	Year	Month	Day
Beginning Date	1994	7	3
		Current Date	
Ending Date	1995	1	3
		Current Date	

Intermediate Results

K_{oc}	126.0	
Estimated dispersivity α	31.01	ft
Hydraulic Conductivity (K)	250.0	ft/day
Seepage Velocity (q_s = v)	0.8621	ft/day
Retardation factor (R)	2.63	
Source Duration Δt	184.0 days	

Beginning Time of Breakthrough Curve

First Arrival	5/20/2002	0.005

Breakthrough Curve Through Maximum Concentration

Mid Point	8/30/2005	0.4233
Additional Point	12/11/2006	0.7224
Maximum	3/24/2008	0.8415

Completion of Breakthrough Curve (for Pulse Sources)

Additional Point	10/20/2009	0.6952
Mid Point	5/18/2011	0.4233
Ending	7/28/2018	0.005000
Duration Above Threshold	5913. days	

Advective Travel Time

Advective Travel Time	7/26/2009	0.7311

First arrival time is 2624. earlier than the advective travel time

Ratio advective to first arrival time 1.912

One Dimensional Transport From a Pulse Source

$$R\frac{\partial c}{\partial t} = D\frac{\partial^2 c}{\partial x^2} - v\frac{\partial c}{\partial x} - \mu c$$

R = retardation factor []
D = dispersion constant [L2/T]
v = seepage velocity [L/T]
μ = first order decay constant [1/T]

with the initial and boundary conditions

http://www.epa.gov/athens/learn2model/part-two/onsite/conc.html

$$
\begin{aligned}
c(x,0) &= 0 \\
c(0,t<\Delta t) &= c_o \\
c(0,t\geq\Delta t) &= 0 \\
\frac{\partial c}{\partial x}(\infty,t) &= 0
\end{aligned}
$$

retardation factor

$R = 1 + \rho_b k_d / \theta$

R = retardation factor
ρ_b = bulk density = $\rho_s (1-\theta)$
ρ_s = solids density
θ = porosity
k_d = (soil) distribution coefficient = $f_{oc} K_{oc}$
f_{oc} = fraction organic carbon
K_{oc} = organic carbon/water partition coefficient

travel time $t_{tr} = x R / v$

t_{tr} = advective travel time *
v = seepage velocity
R = retardation factor
x = distance
* assuming one-dimensional, steady flow, constant gradient

Home | Glossary | Notation | Links | References | Calculators

WCMS
Last updated on Wednesday, January 19, 2011